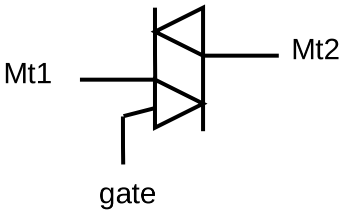
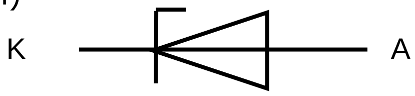
ET 40 - Electrician Theory Examination Marking Schedule

Notes: 1. (1 mark) means that the preceding statement/answer earns 1 mark.

2. This schedule sets out the accepted answers to the examination questions. A marker can exercise their discretion and decide on the overall accuracy of any answer that is presented in the candidate's own words.

3. Symbols and terms - alternatives

Power	W or P
Voltage	V or E or U
Phase	Active

Question 1	*Reference Marks*	*Marking notes*
(a) (i)  • Correct symbol • Correct labels	(½ mark) (½ mark)	
(ii)  • Correct symbol • Correct labels	(½ mark) (½ mark)	+ and – are alternative symbols
(b) Any TWO of: • Better mechanical protection. • Provides increased safety when handled live. • Provides electrical shielding.	(2 marks)	
(c) (i) A circuit breaker	(½ mark)	
(ii) It is the ratio of the MCB minimum tripping current to the MCB current rating.	(1½ marks)	
(d) The impedance is lower because the cable	(2 marks)	

Question 1	*Reference Marks*	*Marking notes*
run is shorter		
(e) (i) • The test instrument is checked to be operating correctly on a known live source. • The equipment is tested to confirm (or otherwise) that it is isolated. • The test instrument is again checked on a known live source to ensure is still operates correctly. (ii) Any ONE of: • Test between each phase and earth. • Test between each phase and neutral.	(1½ marks) (½ mark)	
(f) Any TWO of: • Minimise cable size • Reduce neutral current • Reduce heat • To prevent nuisance tripping on the heaviest loaded phase.	(2 marks)	
(g) (i) 10 milliamps (ii) Earth leakage current	(1 mark) (1 mark)	
(h) Any TWO of: • Capacitor • The start and run windings have different impedances. • The shading ring on a shaded pole motor.	(2 marks)	
(i) (i) Reverse any two phases. (ii) Reverse any two phases on the supply to the starter.	(1 mark) (1 mark)	
(j) Any TWO of: • Current through a filament. • Current through a light-emitting diode • Current through a gas.	(2 marks)	

Question 2	*Reference Marks*	*Marking notes*
(a) (i) $I_P = \frac{V_L}{R}$	(½ mark)	
$= \frac{400}{78.5}$	(½ mark)	
$= 5.1\text{A}$	(1 mark)	
(ii) $I_L = \frac{\sqrt{3} \times V_L}{R}$	(½ mark)	
$= \frac{\sqrt{3} \times 400}{78.5}$	(½ mark)	
$= 8.83\text{A}$	(1 mark)	
(iii) $P = \sqrt{3} \times I_L \times V_L \times pf$	(½ mark)	
$= \sqrt{3} \times 8.83 \times 400 \times 1$	(½ mark)	
$= 6117.42\text{W}$	(1 mark)	
(iv) $P = \frac{6117.42}{3}$	(½ mark)	
$= 2039.14\text{W}$	(½ mark)	
(b) $R = \frac{V^2}{P}$	(½ mark)	
$= \frac{230 \times 230}{2000}$	(½ mark)	
$= 26.45\Omega$	(1 mark)	
$P = \frac{V^2}{R}$		
$= \frac{240 \times 240}{26.45}$		
$= 2177.6\text{W}$	(1 mark)	
Alternative solution $(V_2 / V_1)^2 \times W$ $= (240 / 230)^2 \times 2000$ $= (240 / 230)^2 \times 2000$ $= 2177.6\text{W}$		

Question 3	*Reference Marks*	*Marking notes*

(a) The isolation method has to show:
- Removing the fuses at the switchboard.
- Testing for isolation on the supply side of the DOL starter.
- Using the prove-test-prove method to ensure the motor is isolated.
- Any ONE of:
  - Locking the isolator and attaching a danger tag.
  - Replacing the empty fuse carriers at the switchboard and attaching a danger tag.
	(½ mark)
	(1 mark)
	(1 mark)
	(1 mark)
		Accept other methods that show the motor being safely isolated.

(b) - Ensure all covers are secure. - Replace the danger tag with an out of service tag at the point of isolation.	(½ mark) (½ mark)	
(c) - Insulation resistance test - Insulation resistance test function - 500V d.c. range - Disconnect links on the terminal block - At the unconnected end of the flexible cable test between each phase. - At the unconnected end of the flexible cable test between each phase and earth. - 1MΩ or more	(½ mark) (½ mark) (½ mark) (½ mark) (½ mark) (½ mark) (½ mark)	
(d) The method has to show: - Testing for isolation on the supply side of the DOL starter. - Using the prove-test-prove method to ensure the motor is isolated.	(1 mark) (1 mark)	

Question 4	*Reference Marks*	*Marking notes*
(a) (i) The MEN switchboard.	(1 mark)	
(ii) Any THREE of: • It has an MEN link between the neutral and earth busbars • It is connected to earth via an earth electrode • The MEN switchboard can supply another MEN switchboard • The main neutral can be connected	(3 marks)	
(b) Any TWO of: • Earth rod • Buried electrode • Metallic reinforcing	(1 mark)	
(c) Any THREE of: • The fault current path would flow through the mass of earth to the star point of the distribution transformer. • The impedance of the earth is generally much higher than the main neutral • The fault current may be limited to a value insufficient to operate the protective device. • If protection does not operate there can be a shock hazard on metal-framed appliances.	(3 marks)	
(d) (i) • The earth bar • The earth electrode	(1 mark)	
(ii) A tag warning against disconnection	(1 mark)	

Question 5	*Reference Marks*	*Marking notes*
(a) $N = \frac{60f}{P}$	(½ mark)	
$= \frac{60 \times 50}{2}$	(½ mark)	
$= 1500$ rpm	(½ mark)	
Slip speed = N x slip	(½ mark)	
= 1400 x 4%	(½ mark)	
= 60 rpm	(½ mark)	
Rotor speed = N – slip speed	(½ mark)	
= 1500 - 60	(½ mark)	
= 1440 rpm	(1 mark)	
(b) pf = cosΦ	(½ mark)	
$= \cos 35^0$		
= 0.8191 lag	(½ mark)	
(c) Input power = $\sqrt{3}\, V_L\, I_L \cos\Phi$	(½ mark)	
= $\sqrt{3} \times 400 \times 8.5 \times 0.8191$	(½ mark)	
= 4823 W	(1 mark)	
Output power = input power x efficiency	(½ mark)	
= 4823 x 0.85	(½ mark)	
= 4099 W	(1 mark)	

Question 6	*Reference Marks*	*Marking notes*
(a) (i) A faulty protective earthing conductor circuit (ii) • Repair faulty protective earthing conductor circuit • Conduct a protective earthing conductor test to ensure the resistance is 1Ω or less • Conduct an insulation resistance test to ensure the insulation resistance is 1MΩ or more	(1 mark) (1 mark) (1 mark) (1 mark)	
(b) (i) Any ONE of: • To stress the insulation at a voltage above 325V a.c. (or peak a.c. voltage. • To stress the insulation at a voltage of twice the r.m.s voltage of 250V. (ii) Any ONE of: • To ensure capacitive or inductive reactance does not influence the test result. • A constant maximum voltage is a more stringent test than the momentary peaks of an a.c. waveform.	(1 mark) (1 mark)	
(c) Any TWO of: • MIMS elements absorb moisture. • MIMS elements are electrically safe even though the insulation resistance is well below 1M Ω. • The insulation resistance of MIMS elements rises as the elements heat.	(2 marks)	
(d) To ensure that no phase/neutral transposition has occurred.	(1 mark)	
(e) Any ONE of: • The main neutral is open-circuited • High resistance joint in the main neutral	(1 mark)	

Question 7	*Reference Marks*	*Marking notes*
(a) (i) Any TWO of: ● Because of corrosive environments ● To provide mechanical protection. ● To allow cables to be installed underground ● To allow cables to be installed in concrete ● To provide environmental protection	(2 marks)	
(ii) Any TWO of: ● Impact protection ● Effect of UV rays ● Use of expansion joints ● Environmental conditions	(1 mark)	
(iii) To ensure that any fault on the low voltage system is not transferred to the extra-low voltage system.	(1 mark)	
(b) (i) To prevent cable movement if a high prospective short-circuit current fault occurs.	(2 marks)	
(ii) Any ONE of: ● To ensure that any fault on the low voltage system is not transferred to the telecommunication system. ● To voltage is not induced into the telecommunications system.	(1 mark)	
(iii) The opening through which the cable tray passes is sealed with a fire-resistant sealant.	(1 mark)	
(c) The thermal insulation reduces the current carrying capacity of the cables.	(2 marks)	

Question 8	*Reference Marks*	*Marking notes*
(a) Any TWO of: • Over voltage • Vibration • Ventilation • Frequent switching (in-rush current)	(1 mark)	
(b) (i) Yellow (ii) White	(½ mark) (½ mark)	
(c) (i) • To limit the current flowing through the electrode and tube. • To produce a high voltage when the starter opens to start the tube glowing.	(1 mark) (1 mark)	
(ii) Because the fitting ballast is highly inductive.	(1 mark)	
(iii) Any ONE of: • The lamp does not start. • The lamp only glows at the ends. • The lamp does not strike.	(1 mark)	
(iv) To reduce the stroboscopic effect of the fluorescent lighting.	(1 mark)	
(d) • Sufficient light for the application • Minimum glare • Uniform light • Correct colour	(2 marks)	
(e) Any TWO of: • Do not touch with naked finger • Install in horizontal position only • Do not cause excessive vibration	(1 mark)	

Question 9	*Marks*	*Reference*	*Marking notes*
(a) • There is an imbalance between the neutral current and the sum of the phase currents • A magnetic field is induced into the iron core. • The induced magnetic field induces a voltage in the sensing coil • The tripping coil is energised, opening the RCD contacts	(1 mark) (1 mark) (1 mark) (1 mark)		
(b) It has to be tested to ensure that it is voltage-dependent (that is, it will not automatically reset if supply is restored.)	(2 marks)		
(c) Any TWO of: • Install RCD at the switchboard at the origin of the final subcircuit. • Install an SRCD on the bathroom socket outlet. • Install an SRCD on a socket outlet upstream from the 1st new socket outlet.	(2 marks)		
(d) • Overcurrent • Short circuits	(1 mark)		
(e) Yes The RCD detects the imbalance regardless of the polarity of the supply.	(½ mark) (½ mark)		